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Integrated micro/nanofibrous PLGA-Collagen scaffolds for bladder tissue regeneration

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Fabrication of an ideal scaffold mimicking the native extracellular matrix components, structure and function has remained a challenge in tissue engineering. The basic structural element in ECM is collagen type I with a fibrillar nano-scale structure. Collagen nanofibers can be fabricated using electrospinning or plastic compression (PC) of collagen hydrogel. PC is a simple and fast method, which has appeared better than electrospinning, since fluoroalchoholic solvents used in collagen electrospinning denature collagen to gelatin. The collagen layer obtained from PC contains small inter-fiber pores limiting cell infiltration and is mechanically weak. Performing collagen PC onto another polymeric substrate leads to a two-layered construct with improved mechanical properties. Here, we present the design of a hybrid, electrospun poly(lactic-co-glycolide) (PLGA) - plastically compressed (PC) collagen scaffold that could allow bladder mucosa expansion. Optimisation of electrospinning was performed in order to obtain increased pore sizes and porosity to consolidate the construct and to support neovascularisation and tissue ingrowth. The PLGA support scaffold was placed between two collagen gels, and the minced tissue was distributed either on top or both on top and inside the construct prior to PC; this was then cultured for up to four weeks. Morphology, histology and SEM demonstrated that the construct maintained its integrity throughout cell culture. Cells from minced tissue migrated, expanded and re-organised to a confluent cell layer on the top of the construct after two weeks and formed a multilayered urothelium after four weeks. Cell morphology and phenotypewas typical for urothelial mucosa during tissue culture.